SS 1608B DCS/ ECS SAT PROCEDURE

SATORP
Jubail Export Refinery Project

Invensys Ref: ME85009
Invensys Process Systems

Revision	00	01	02	03	04	05
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REVISION	DATE	DESCRIPTION
00	06-Jan-2012	Issued for Acceptance

HOLDS LIST

HOLD NUMBER	SECTION	DATE ENTERED	CHANGE ORDER NUMBER	DESCRIPTION	DATE CLEARED

Reference Documents

Invensys Documents

2271-PCS-PRJ-002	PCS System Development Plan
2271-PCS-PRJ-005	PCS Project Quality Plan
2271-PCS-FDS-001	PCS Networks & Cyber Security FDS
2271-PCS-FDS-002	PCS Cabinets FDS
2271-PCS-FDS-003	TMR Systems – ESD, FGS & CCS FDS
2271-PCS-FDS-004	PCS Communication Interfaces FDS
2271-PCS-FDS-005	PCS Database Structure and Transfer Methodology FDS
2271-PCS-FDS-006	DCS & ECS Systems FDS
2271-PCS-FDS-007	Operator Training Simulator FDS
2271-PCS-FDS-008	Machine Condition Monitoring FDS
2271-PCS-FDS-009	Process Monitoring CCTV FDS
2271-PCS-FDS-010	PCS Alarm Management FDS
2271-PCS-FDS-011	Blending and Material Movements - Refinery Offsite Management Solution Suite FDS
2271-PCS-FDS-012	PCS Asset Management FDS
2271-PCS-FDS-013	PCS Human Interface FDS
2271-PCS-FDS-014	DAHS, PCS Historian and Reports FDS
2271-PCS-FDS-015	Maintenance Training System FDS
2271-PCS-FDS-016	PCS Integrated Control Software FDS
2271-PCS-FDS-017	Advanced Process Control FDS
2271-PCS-FDS-018	Pipe Line Monitoring and Control FDS
2271-PCS-FDS-019	ESD TMR Systems FDS
2271-PCS-FDS-020	F&G TMR Systems FDS
2271-PCS-FDS-021	CCS TMR Systems FDS
2271-PCS-FDS-022	PCS Control Strategies FDS
2271-PCS-PHC-001	PCS Power & Heat Calculation Template.
2271-PCS-ITP-001	PCS FAT and IFAT Plan
2271-PCS-ITF-001	Inspection and Test Form Template – DCS and ECS Systems
2271-PCS-ITF-002	Inspection and Test Form Template – TMR systems
2271-PCS-ITF-003	Inspection and Test Form Template – MMS Systems
2271-PCS-ITF-004	Inspection and Test Form Template – CCTV Systems
2271-PCS-ITF-005	Inspection and Test Form Template – OTS and BLM Systems

Invensys Drawings

2271-PCS-ARC-001	PCS Architecture
2271-PCS-ARC-002	PCS Network Drawings
2271-PCS-CAB-001	PCS Cabinet Drawings
2271-PCS-CAB-002	PCS Cabinet Block Diagram
2271-PCS-TWS-001	PCS Typical Wiring Schematics
2271-PCS-TIW-001	PCS Typical Internal Wiring Schematics

Jubail Export Refinery Engineering Standards

JERES-B-058	Emergency Shutdown, Isolation and Depressuring
JERES-J-003	Basic Design Criteria
JERES-J-005	Instrument Drawings and Forms
JERES-J-601	Emergency Shutdown and Isolation Systems
JERES-J-602	BMS, Combustion and Waterside Control Systems for Water Tube Boilers
JERES-J-603	Process Heater Safety Systems
JERES-J-604	Protective & Condition Monitoring Eq. for Rotating Machinery
JERES-J-801	Control Buildings
JERES-J-902	Electrical System for Instrumentation
JERES-J-903	Intrinsically Safe System
JERES-P-127	Electrical Control System
JERES-T-625	Inter & Intra Building Fibre Optic Communication Cables
JERES-Z-001	Process Control System
JERES-Z-003	Pipeline Leak Detection Systems
JERES-Z-010	Process Automation Networks Connectivity

Jubail Export Refinery Materials Specifications

JERMS-J-4623	Programmable Controller Based ESD Systems
JERMS-J-4625	Machinery Protection System
JERMS-J-4634	Local ZV Control Systems
JERMS-J-4716	Pneumatic Actuators On-Off Service
JERMS-J-4813	Instrumentation & Thermocouples Cables
JERMS-J-4820	Instrument Control Cabinets – Indoor
JERMS-T-8625	Fibre Optic Cable Specification
JERMS-Z-3010	Distributed Control System
JERMS-Z-3020	Supervisory Control and Data Acquisition (SCADA) Systems
JERMS-Z-3030	Remote Terminal Units

Jubail Export Refinery Engineering Procedures

JEREP-111	Instrument Database Management
JEREP-112	SmartPlant Instrumentation User Guide
JEREP-200	Document Management & Final Documentation Requirements
JEREP-624	Preparation of System Design Documents
JEREP-626	Configuration and Graphics Guidelines
JEREP-634	Factory Acceptance Test
JEREP-636	Installation and Checkout Plan
JEREP-638	Site Acceptance Test
JEREP-640	Process Automation Networks & Systems Security

Jubail Export Refinery Project Procedures

2271-AAA-JSM-201	Item Numbering and Coding Procedure

General Design Rules (Job Specification – Design)

2271-AAA-JSD-1500-01	JSD for Instrumentation & Automation (Guidelines for EPC Bidding)
2271-AAA-JSD-1500-02	JSD for Instrumentation & Automation
2271-AAA-JSD-1501-01	JSD for Instrument Numbering
2271-AAA-JSD-1522-01	JSD for Instrument/ Electrical Interface
2271-AAA-JSD-1540-01	JSD for Instrumentation
2271-AAA-JSD-1560-01	JSD for Analyzer Maintenance and Data System (AMDS)
2271-AAA-JSD-1570-01	JSD for Installation and Testing of Instr. & CTRL Systems
2271-AAA-JSD-1580-01	JSD for Packages Instrumentation
2271-AAA-JSD-1900-03	Design Safety Concept
2271-701-JSD-1510-01	JSD for Control & Safety System Philosophy
2271-701-JSD-1510-02	JSD for Control & Safety System Philosophy for OSBL Marine Terminal
2271-701-JSD-1510-03	JSD for Asset Management System (AMS)
2271-701-JSD-1510-04	JSD for Data Acquisition and Historization System (DAHS)
2271-701-JSD-1510-05	JSD for Maintenance Training Simulator (MTS)
2271-701-JSD-1510-07	JSD for Alarm Management System (ALMS)
2271-701-JSD-1518-02	JSD for Operator Training Simulator (OTS)

General Supply Rules (Job Specification – Supply)

2271-701-JSS-1510-01	JSS for PCS Functional Specification
2271-701-JSS-1510-02	JSS for PCS Vendor Services
2271-701-JSS-1510-03	JSS for PCS Configuration Guidelines
2271-701-JSS-1515-01	JSS for ESD System
2271-701-JSS-1515-02	JSS for CCS System
2271-701-JSS-1515-03	JSS for Process Closed Circuit Television System (CCTV)
2271-701-JSS-1515-04	JSS for Fire & Gas System
2271-AAA-JSS-1516-01	JSS for Tank Gauging System (TGS)
2271-AAA-JSS-1563-01	JSS for Corrosion Monitoring System (CRMS)

General Supply Rules (Job Specification – Drawings)

2271-701-DW-1512-001	ISBL Control and Safety Systems Connection Diagram
2271-701-DW-1512-002	PCS Architecture Block Diagram
2271-701-DW-1512-003	ISBL FO Cable Block Diagram
2271-701-DW-1512-005	PCS Architecture Block Diagram OSBL
2271-701-DW-1512-006	OSBL FO Cable Block Diagram
2271-701-DW-1522-001	Instrument Power Supply Distribution Typical Single Line Diagram

Non Material (NM Specification)

2271-AAA-NM-1500-01	Instrumentation & Control System EPC Contractors Responsibility Matrix
2271-AAA-NM-1500-02	Instrumentation & Control System EPC Contractors Cabling Interface Points

Reference Web Sites

- Invensys Triconex System – www.triconex.com/
- Invensys Foxboro I/A System – www.foxboro.com/
- FDT Group – www.fdtgroup.org

Table of Contents

Glossary

General project abbreviations and system terminology are listed below, with specific abbreviations identified in the text of each section.

ALMS	Alarm Management System
AMDS	Analyser Maintenance and Data System
AMS	Asset Management System
APM	Advance Process Monitoring
BLM	Basic Learning Model
BOSS	Blend Optimisation and Supervisory System
BPD	Barrels Per Day
BPO	Blend Plan Optimisation
BTM	Batch Tracking Manager
C&E	Cause and Effect
CCS	Compressor Control System
CCTV	Closed Circuit Television
CDR	Critical Design Review
DAHS	Data Acquisition and Historian System
DCS	Distributed Control System
DDS	Detailed Design Specification
ECS	Electrical Control System
EPC	Engineering Procurement Construction
ESD	Emergency Shutdown System
CCS	Fire and Gas
FAT	Factory Acceptance Test
FDS	Functional Design Specification
FEED	Front End Engineering Design
FGS	Fire and Gas System
FOB	Free On Board
FOD	Field Operator Display
HMI	Human Machine Interface
HSE	Health Safety Environmental
HW	Hardware
I/A	Intelligent Automation
I/O	Input Output
IC	Initial Condition (file defining process state)
ICP	Installation and Check out Plan
ICT	Invensys Core Team

IET	Invensys Local EPC Team
IFA	Issued For Approval
IFAT	Integrated Factory Acceptance Test
IPS	Invensys Process Systems
ITP	Inspection and Test Plan
JER	Jubail Export Refinery
JEREP	Jubail export Refinery Engineering Procedures
JERES	Jubail Export Refinery Engineering Standards
JERMS	Jubail Export Refinery Materials Specifications
JSD	Job Specification Design
JSS	Job Specification Supply
KOM	Kick Off Meeting
LSZH	Low Smoke Zero Halogen
MCC	Motor Control Centre
MMS	Machine Maintenance System
MOM	Minutes of Meeting
MP	Main Processor
MTS	Maintenance Training System
MVT	OTS (Process) Model Validation Test
NCR	Non Conformance Report
NMR	Non Material Requisition
NTP	Network Time Protocol
OMM	Order Movement Management
OSBL	Out Side Battery Limits
OTS	Operator Training Simulator
OGC	Operator Group Console
P&ID	Process and Instrumentation Diagram
PAT	Performance Acceptance Test
PCS	Process Control System
PDR	Preliminary Design Review
PEFS	Process Engineering Flow Scheme
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
PMT	Programme Management Team
QA	Quality Assurance
QC	Quality Control
SAT	Site Acceptance Test
SATORP	Saudi Aramco and Total Refinery and Petrochemical SATORP
SCADA	Supervisory Control And Data Acquisition

SCT	SATORP PCS Core Team
SDD	System Design Document
SDP	System Development Plan
SET	SATORP EPC Team
SIL	Safety Integrity Level
SOE	Sequence of Events
SRR	System Readiness Review
TCM	Triconex Communication Module
TGS	Tank Gauging System
TIS	Tank Information System
TMC	Turbo Machinery Control
TMR	Triple Modular Redundant
TQ	Technical Query
TR	Test Report
TRX	Triconex
UCP	Unit Control Panel
VMS	Vibration Monitoring System
WBS	Work Breakdown Structure

1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this test procedure is to accurately inspect and test the SS 1608B after installation and prior to Commissioning activities.

This procedure does not cover equipment not supplied by the PCS Vendor but references these where required to confirm the proper operation of the SS 1608B.

1.2 Overview

The PCS DCS SAT Procedure details the basic requirements for inspection and testing of the installed SS 1608B.

All Shipments of SS 1608B shall be:

- Visual Inspection of the cabinets
- Component Verification
- Power on Test including diagnostic Alarm and Redundancy.
- Validation testing of System Cable installation
- Validation Testing of Multicore cable Installation between PCS Cabinets
- Unstructured Testing

1.3 Test Equipment

The following test equipments shall be kept ready for use during Test. A valid calibration certificate shall be produced along with the test equipment for verification prior to test.

- Multi Meter
- Signal Generator
- Wiring Tools (Screw Driver, wire stripper etc)

1.4 Prerequisites

All the SS 1608B shall have completed the Installation and Check out phase and the Installation Certificate completed.

Start up spares and test equipment available.

SAT Schedule completed by EPC.

Required personnel specified by EPC are available for the expected duration of the SAT.

Safety Procedures in place and all personnel inducted and aware.

PCS Vendor As Built documentation for the SS 1608B available.

1.5 PCS Vendor Personnel and Responsibilities

Team Members responsibilities are as follows:

Team Member	Responsibilities
Project Manager	Overall responsibility for the Project.
Test Team Supervisor	Test supervision. Focal point for test issues.
Quality Manager (Part)	Responsible for ensuring the quality and handling quality related issues.
Test Executor(s)	PCS Vendor engineer in charge of particular tests (Hardware).
Technical Support	Hardware and Software specialists for specific technical issues.
PCS Core Team	Technical Authority and Review of Global TRs

One team member may be allocated multiple duties as applicable.

1.6 EPC Personnel Requirements and Responsibilities

EPC shall assign the following personnel to the test team.

Team Member	Responsibilities
Project Engineer	Responsible for the SAT on behalf of EPC An engineer with delegated approval authority on behalf of EPC. Responsible for review and approval of test documentation. Responsible for SAT acceptance.
Package Inspector	Responsible for system hardware inspection.
Test Engineers	Responsible for the testing, witnessing and participating in the SAT as directed by the respective test Team Co-ordinator.

One team member may be allocated multiple duties as applicable.

Note: One of the above personnel must have authority for accepting the PCS system on behalf of the EPC designated approving authority, and shall be named prior to start of SAT.

1.7 Test Schedule

The project SAT phase will be detailed in the EPC Site Activities Schedule. A detailed schedule will be provided, indicating required resource levels and parallel tasks being performed. PCS Vendor will provide indicative resource requirements against the EPC SAT Schedule during development, when requested by EPC.

1.8 Test Documentation Sign Off

After completion of each test, the PCS Vendor and SATORP/EPCs engineers shall sign the appropriate sign-off sheet within the SAT Procedures document. Any supplementary literature – initialled Interface and Connection Schedules etc. shall be filed with the SAT procedure for future reference.

A Test Report (TR) database (Exception List) shall be maintained by PCS Vendor during installation and check out. All problems that have occurred, equipment shortages, system deficiencies and other observations shall be recorded. Each TR shall be passed to the respective Installation Supervisor to decide on the corrective action. Signed off copies of the TR sheets and summary sheet shall be collated with the Test Procedures document for future reference. A sample Test Report sheet is provided in the appendices.

On completion of all tests, the SATORP/EPCs approving authorities will be required to sign-off the SAT Completion Certificate, subject to any TRs.

1.9 SAT Completion

On completion of the SAT, the SATORP/EPCs approving Engineers will sign a Completion of SAT Certificate. Any outstanding non-conformance will be recorded on this certificate, with a view to completion within an agreed period.

2 VISUAL CHECKS

Objective Outline:

The purpose of this inspection is to ensure that all SS 1608B supplied by PCS Vendor has not been damaged during installation.

Criteria:

The equipment should not have any external defects such as deformities / scratches that might impair the product quality or appearance and all items must be labelled properly for easy identification.

Procedure:

Cabinets' doors should be opened to confirm proper operation and that the internal equipment has not moved during installation using the General Arrangement Drawing. Record results in APPENDIX B – CABINET VISUAL INSPECTION CHECKLISTS.

Visual Check		
PASS/FAIL CRITERIA		Comments
All installed equipment should be inspected for damage	☐	
All cabinets internal arrangement checked against As Built General Arrangement Drawings Check sheets in Appendix B completed for all cabinets	☐	

Visual Checks

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No / Date
General Arrangement Drawings	Refer to Appendix B	

C: Inspected

Inspected By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

3 POWER ON CHECKS

Objective Outline:

The purpose of this test is to ensure the System Hardware is functionally correct in all respect like redundancy, alarm indication and voltage segregation after Power on. All power distributions are in accordance with the approved PCS Vendor documents.

Criteria:

Installation and Check out phase is completed with the connection of ac supplies to the cabinet.

Test Procedure:

The following test is to ensure proper power feed is connected to the system prior to power on.

1. Check a 120V AC supplies to incoming AC supply terminals / MCB.

3.1 Redundant Cabinet Power (120V AC UPS)

1. Switch 'ON' primary A and secondary B MCB, check voltage on its output terminals.
2. Switch 'ON' individual MCBs and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Chassis, 24V DC PSU units by checking the ON indication (LED) where available.
3. Power Distribution Alarm, where available, is normal (Alarm terminals short-circuit)
4. Switch off the supply to each "A" supply device by turning the appropriate "A" AC Supply MCB to "OFF"
5. ON indication (LED) on front of associated simplex device goes off.
6. Confirm all associated redundant devices are healthy.
7. Power Distribution Alarm, Chassis PSU failure Alarm, where available, goes to alarm (Alarm terminals open circuit).
8. Return the MCB to "ON" and proceed to the next device.
9. Power Distribution Alarm, Chassis PSU failure Alarm, where available, is normal (Alarm terminals short-circuit).
10. Repeat the same steps for UPS B incomer 120VAC.

3.2 Simplex Cabinet Power (120V AC UPS)

1. Power Distribution Alarm, where available, is in alarm (Alarm terminals open-circuit).
2. Switch 'ON' 120V AC MCB, check voltage on its output terminals.
3. Switch 'ON' individual MCBs and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Chassis, 24V DC PSU units by checking the ON indication (LED) where available.
4. Power Distribution Alarm, where available, is normal (Alarm terminals short-circuit).

3.3 Utility Cabinet Power and Ventilation Alarm Check

1. Switch 'ON' 120V AC MCB, check voltage on its output terminals and utility socket.
2. Close individual Fuse terminals and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Fans and Lights.

3. Ensure the Light is on and the Motion sensor works properly.
4. Check the Thermostat is set at 50°.
5. Ensure the Ventilation Alarm is normal (Alarm terminals short-circuit).
6. Change thermostat set point to below ambient temperature and Ensure the Ventilation Alarm changes state to alarm (Alarm terminals Open-circuit).
7. Reset the thermostat switch setting back to normal and ventilation alarm in normal condition.
8. Switch Fan-1 'OFF' at the utility distribution and check Ventilation Alarm changes state to alarm (Alarm terminals Open-circuit).
9. Switch 'ON' FAN-1 and ensure the ventilation alarm is in normal condition.
10. Repeat the same Fan failure test for Fan-2 and observe the changes.

3.4 DC Power Distribution (24V DC)

1. Switch 'ON' each power supply / MCB and check voltage on its output terminals respectively. Also check voltage on the input and output side of the sub-distribution MCBs, Fuse Terminals and Alarm Fuse Modules.
2. Ensure no Fuse Failure Indication and Power Distribution Alarm is normal (Alarm terminals short-circuit)
3. Switch 'OFF' the primary power supply and ensure all the secondary distribution is still holding 24VDC.
4. Power Distribution Alarm goes to alarm (Alarm terminals open-circuit) indicating Power supply failure.
5. Switch 'ON' the primary power and ensure the Power Distribution Alarm is normal (Alarm terminals short-circuit).
6. Repeat the above test for Secondary Power Supply.
7. Alarm Fuse Module test - fit a Blown fuse or short the terminals in each Alarm Fuse Module. Ensure Blow Fuse indication and Fuse Failure alarm is reported by checking the associated relay and Power Distribution Alarm is in alarm condition (Alarm terminals open-circuit).
8. Replace the fuse and check for Power Distribution Alarm is normal (Alarm terminals short-circuit).
9. For cabinets having single 24VDC distribution the output terminal of the Diode Oring Unit shall be tested for the 24VDC availability when primary or secondary fails.

Note: Using a test meter measure the power supply output voltage of each Power supply module (off load) and ensure that the measured voltage is 24V DC + 5%. If the DC voltage is outside of the specified limit, adjust power supply output in accordance with the manufacturer's guide.

3.5 System healthiness

Ensure the system healthiness as below:

1. Ensure the I/A System Manager does not show any alarm

Power On Checks		
PASS/FAIL CRITERIA	SAT	Comments
Following ICP all PCS equipment shall be bonded to Safety Ground.		
Following ICP all PCS Equipment should be powered, Check a 120V AC supplies to incoming AC supply terminals / MCB.		
Redundant Cabinet Power (120V AC UPS)		
Switch 'ON' primary A and secondary B MCB, check voltage on its output terminals.	☐	
Switch 'ON' individual MCBs and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Chassis, 24V DC PSU units by checking the ON indication (LED) where available	☐	
Power Distribution Alarm, where available, is normal (Alarm terminals short-circuit)	☐	
Switch off the supply to each "A" supply device by turning the appropriate "A" AC Supply MCB to "OFF"	☐	
ON indication (LED) on front of associated simplex device goes off.	☐	
Confirm all associated redundant devices are healthy.	☐	
Power Distribution Alarm, Chassis PSU failure Alarm, where available, goes to alarm (Alarm terminals open-circuit).	☐	
Return the MCB to "ON" and proceed to the next device.	☐	
Power Distribution Alarm, Chassis PSU failure Alarm, where available, is normal (Alarm terminals short-circuit).	☐	
Repeat the same steps for UPS B incomer 120VAC	☐	
Simplex Cabinet Power (120V AC UPS)		
Power Distribution Alarm, where available, is in alarm (Alarm terminals open-circuit).	☐	
Switch 'ON' 120V AC MCB, check voltage on its output terminals.	☐	
Switch 'ON' individual MCBs and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Chassis, 24V DC PSU units by checking the ON indication (LED) where available	☐	
Power Distribution Alarm, where available, is normal (Alarm terminals short-circuit)	☐	

Power On Checks		
PASS/FAIL CRITERIA	SAT	Comments
Utility Cabinet Power and Ventilation Alarm Check		
Switch 'ON' 120V AC MCB, check voltage on its output terminals and utility socket.	☐	
Close individual Fuse terminals and check voltage on its output terminals, ensure the respective output devices are 'ON' such as Fans and Lights.	☐	
Ensure the Light is on and the Motion sensor works properly	☐	
Check the Thermostat is set at 50°.	☐	
Ensure the Ventilation Alarm is normal (Alarm terminals short-circuit).	☐	
Change thermostat set point to below ambient temperature and Ensure the Ventilation Alarm changes state to alarm (Alarm terminals Open-circuit).	☐	
Reset the thermostat switch setting back to normal and ventilation alarm in normal condition.	☐	
Switch Fan-1 'OFF' at the utility distribution and check Ventilation Alarm changes state to alarm (Alarm terminals Open-circuit).	☐	
Switch 'ON' FAN-1 and ensure the ventilation alarm is in normal condition.	☐	
Repeat the same Fan failure test for Fan-2 and observe the changes.	☐	
DC Power Distribution (24V DC)		
Switch 'ON' each power supply / MCB and check voltage on its output terminals respectively. Also check voltage on the input and output side of the sub-distribution MCBs, Fuse Terminals and Alarm Fuse Modules.	☐	
Ensure no Fuse Failure Indication and Power Distribution Alarm is normal (Alarm terminals short-circuit)	☐	
Switch 'OFF' the primary power supply and ensure all the secondary distribution is still holding 24VDC.	☐	
Power Distribution Alarm goes to alarm (Alarm terminals open-circuit) indicating Power supply failure	☐	
Switch 'ON' the primary power and ensure the Power Distribution Alarm is normal (Alarm terminals short-circuit).	☐	

Power On Checks		
PASS/FAIL CRITERIA	SAT	Comments
Repeat the above test for Secondary Power Supply.	☐	
Alarm Fuse Module test - fit a Blown fuse or short the terminals in each Alarm Fuse Module. Ensure Blow Fuse indication and Fuse Failure alarm is reported by checking the associated relay and Power Distribution Alarm is in alarm condition (Alarm terminals open-circuit).	☐	
Replace the fuse and check for Power Distribution Alarm is normal (Alarm terminals short-circuit).	☐	
For cabinets having single 24VDC distribution the output terminal of the Diode Oring Unit shall be tested for the 24VDC availability when primary or secondary fails.	☐	
System Healthiness		
Ensure the I/A System Manager does not show any alarm	☐	

Power On Checks

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

4 POWER REDUNDANCY TEST

Objective Outline:

The purpose of this test is to ensure the operation of the redundant power supply.

NOTE: Ensure all system cabinets have passed all system cabinet test cases, and all AC connections have been properly and correctly connected prior to applying power to the system.

Criteria:

System is able to operate on Power Module A and B, no Power Module Alarm.

Time Required:

Estimated time required for conducting this test is approximately 1 hour per System.

Test Procedure:

1. Switch MCBs that power Primary PSUs to “OFF” for simulating a single mode power failure during operation.
2. Verify that the system is not halted by randomly forcing at least one signal from each system cabinet and check for the expected result.
3. Switch the MCBs that that power Primary PSUs back to “ON” again.
4. Repeat Step 1 to 3 on for the Secondary PSUs and ensure testing results are identical to the removal of Primary PSUs.
5. Repeat Step 1 to 4 on each DCS Cabinet. Ensure test results are identical to the tests carried out on the first DCS System Cabinet

Power Redundancy Test		
PASS/FAIL CRITERIA	SAT	Comments
The system operation did not halt and the forced input/output had produced the expected result.	☐	
Step **1 to** Error! Reference source not found. were repeated on the first DCS System Cabinet and the testing results were identical to the Primary PSUs	☐	
Step **1 to 4** were repeated on other DCS System Cabinets. The testing results were identical to First DCS System Cabinet, as stated in step 1 to 4	☐	

Power Redundancy Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev 02
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

5 WORKSTATION VALIDATION TEST

Objective Outline:

The purpose of this procedure is to confirm the DCS workstations are correctly configured.

Criteria:

There should not be software loaded on the workstation that is not detailed in the documentation.

Test Procedure:

1. Review antivirus to confirm latest updates have been installed.
2. Review all software files installed on the workstation to ensure that all the latest revisions are present and that no additional software has been loaded.
3. Confirm USB Ports are locked down.
4. Confirm DVD drives are locked down.
5. Repeat **Steps 1 to 4** for each workstation.

DCS Workstation Validation Test		
PASS/FAIL CRITERIA	SAT	Comments
Review antivirus to confirm latest updates have been installed.	☐	
Review all software files installed on the workstation to ensure that all the latest revisions are present and that no additional software has been loaded.	☐	
Confirm USB Ports are locked down.	☐	
Confirm DVD drives are locked down	☐	
Repeat **Steps 1 to 4** for each workstation		

Workstation Validation Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents		
Title	Invensys Document No.	Revision No
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev 02
PCS Workstation Setup		Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested		
Tested By (Invensys personnel):		
Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness		
Witnessed By (SATORP personnel):		
Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance		
Accepted By (EPC personnel):		
Print Name	Signature	Date DD/MM/YY

6 SWITCH PORTS AND CABLE TEST

Objective Outline:

The purpose of this procedure is to test and confirm the DCS switch port functionality and the cable connectivity.

Criteria:

There should not be any abnormalities with respect to switch port and cable connected.

Test Procedure:

6. For link A of primary switch disconnect the port cable from either end.
7. Reconnect the link and acknowledge alarms.
8. For link B of secondary switch disconnect the same positioned port cable from either end.
9. Reconnect the link and acknowledge alarms.
10. Disconnect the same ports on both primary and secondary switches.
11. Reconnect the link and acknowledge alarms.
12. Repeat steps 1 to 7 for all other ports on the switch.

DCS Switch Port and Cable Test		
PASS/FAIL CRITERIA	SAT	Comments
Confirm communication is transferred via the secondary switch. Confirm port failure of primary switch is reported to System Monitor.	☐	
Communications recovered.	☐	
Confirm communication is transferred via the primary switch. Confirm port failure of secondary switch is reported to System Monitor.	☐	
Communications recovered.	☐	
Confirm same port failure on both the primary and secondary switch is reported to System Monitor.	☐	
Communications recovered.	☐	
Mark off and initial each connection on PCS System Architecture detailed in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM Attach in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM as passed.	☐	

DCS Switch Port & Cable Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

7 SWITCH UPLINK TEST

Objective Outline:

The purpose of this procedure is to test and confirm the DCS switch communication uplink functionality.

Criteria:

There should not be any abnormalities with respect to primary and secondary switch uplink functionality.

Test Procedure:

1. For uplink of primary switch disconnect the cable from either end.
2. Reconnect the uplink cable and acknowledge alarms.
3. For uplink of secondary switch disconnect the same positioned cable from either end.
4. Reconnect the link and acknowledge alarms.
5. Repeat steps 1 to 4 for any additional uplinks on the switch.

Switch Uplink Test		
PASS/FAIL CRITERIA	SAT	Comments
Confirm communication is transferred via the secondary switch. Confirm uplink failure of primary switch is reported to System Monitor. Confirm Primary Network has re-converged.	☐	
Communications recovered.	☐	
Confirm communication is transferred via the primary switch. Confirm uplink failure of secondary switch is reported to System Monitor. Confirm Secondary Network has re-converged.	☐	
Communications recovered.	☐	
Mark off and initial each connection on PCS System Architecture detailed in in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM Attach in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM as passed.	☐	

Switch Uplink Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents		
Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

8 FCP CABLE TEST

Objective Outline:

The purpose of this procedure is to test and confirm the functionality of the redundant FCP communication cabling.

Criteria:

There should not be any abnormalities with respect to FCP Cable connectivity.

Test Procedure:

1. Disconnect cable A of the FCP.
2. Reconnect the link and acknowledge alarms.
3. Pull cable B of the FCP.
4. Reconnect the link and acknowledge alarms.
5. Repeat steps 1 to 4 for each FCP.

FCP Cable Test		
PASS/FAIL CRITERIA	SAT	Comments
Confirm cable A failure in System Monitor.	☐	
Communications recovered.	☐	
Confirm cable B failure in System Monitor.	☐	
Communications recovered.	☐	
Mark off and initial each connection on PCS System Architecture detailed in in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM Attach in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM as passed.	☐	

FCP Cable Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03
PIB/SS FCP Loading	SA-JER-PIAAA-PIXJ-070202	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

9 FCP FAULT TOLERANCE TEST

Objective Outline:

The purpose of this test is to ensure the DCS Hardware Primary Field Control Processor (FCP270) functionality as per the SATORP/ EPC approved PCS Vendor documents.

Criteria:

There should not be any abnormalities with respect to the Primary Control Processor functionality.

Test Procedure:

1. Connect MESH fibre cables to port A and port B.
2. Reset the FCP270.
3. Observe Red and Green status LEDs on the FCP270. The FCP have a similar boot sequence.
4. View the FCP270 Equipment Information display page for operational, hardware and software information.
5. The following FCP270 configuration design parameters are;
   a) Boot host;
   b) MAC address;
   c) IP address;
   d) Fault Tolerant mode.
6. Verify the Image version, (normally the latest version).

FCP Fault Tolerance Test		
PASS/FAIL CRITERIA	SAT	Comments
Confirm that the correct Letterbug is set using the Letterbug configurator.	☐	
Both FO Cables are connected to FCP.	☐	
Call up a display, which contains a PID or any analogue or digital value with a trend within that FCP. Remove primary FCP module from base plate. Confirm switching from primary to shadow has no effect on the operation of the control loop/trend.	☐	
Confirm in System Management, that the shadow module has taken over control and a system alarm for that station has been triggered	☐	
Restore faults. Confirm system alarm is cleared.	☐	
Repeat steps simulating a failure of the SHADOW module	☐	
Repeat steps for all other FCP on the Mesh Network. Mark off and initial each connection on PCS System Architecture detailed in in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM Attach in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM as passed.	☐	

FCP Fault Tolerance Test

A: System Identification	
DCS Area	DCS Area 3
Location	SS 1608B

B: Reference Documents		
Title	Invensys Document No.	Revision No
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested		
Tested By (Invensys personnel):		
Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness		
Witnessed By (SATORP personnel):		
Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance		
Accepted By (EPC personnel):		
Print Name	Signature	Date DD/MM/YY

10 FOXBORO FIELD BUS COMMUNICATION & IO MODULE TEST

Objective Outline:

The purpose of this procedure is to test and confirm the DCS Hardware Fieldbus Communication and I/O Modules functionality as per the SATORP/ EPC approved PCS Vendor documents.

Serial Communication FBMs are not part of this test and are tested as part of Communication Link Tests.

Criteria:

There should not be any abnormalities with respect to the Fieldbus Communication and I/O Modules functionality.

Test Procedure:

1. Go to the equipment change display in the system manager and select all Fieldbus modules on-line.
2. Check the configuration of all the Fieldbus modules.
3. Check Field Bus switching .Select Bus A only, then Bus B only.

Field Bus Communication & IO Module Test		
PASS/FAIL CRITERIA	SAT	Comments
Fieldbus module images are correct.	☐	
All Fieldbus modules are online and healthy.	☐	
Design parameters of FBM are configured correctly.	☐	
All FBMs should be healthy on single bus also.	☐	
Repeat test for all FCPs, as per PCS System Architecture detailed in APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM Attach APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM as passed.	☐	

Field Bus Communication & IO Module Test

A: System Identification

DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

11 INPUT SYSTEM CABLE VALIDATION TEST

Objective Outline:

The purpose of this test is to verify that the system cables for all the modules have been correctly installed.

Sample Input Loop configurations conform to the SATORP/ EPC approved PCS Vendor documents from the Marshalling Cabinet all the way through DCS FoxSelect display.

NOTE:

Input testing can be achieved using a 'short link' for digital inputs and a current generator for Analogue inputs. One input per Termination Assembly shall be tested. The shorting link will give a binary Logic 1 status when applied to a Digital Input and the current generator will change from 0mA BadValue to a valid current reading.

The I/O Allocation and marshalling Wiring Schedule reports may also be used as references for performing these checks. I/O Test and Loop Test Report may be used to verify and ticked off.

Criteria:

There should not be any abnormalities with respect to the Input being tested.

Test Procedure:

1. Open the corresponding Block Template in the DCS Workstation FoxSelect
2. Activate one selected input per Termination Assembly (System Cable) by simulating closing the contact or short circuit condition using a 'short link' for digital or current generator set at 12mA for Analogue points.
3. Check change in state on the DCS FoxSelect Display, ON Text Active for Digital points and Bad Value indication is removed for the point on the DCS display and the Alarm Display for Analogue points
4. Record results

I/P System Cable Validation Test		
PASS/FAIL CRITERIA	SAT	Comments
Verify using one Input per Termination Assembly that the input system cables have been correctly installed.	☐	
The Value indicated on the DCS FoxSelect Screen shall indicate "shorted link" condition or good Analogue value.	☐	

I/P System Cable Validation Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents		
Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested		
Tested By (Invensys personnel):		
Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness		
Witnessed By (SATORP personnel):		
Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance		
Accepted By (EPC personnel):		
Print Name	Signature	Date DD/MM/YY

12 OUTPUT SYSTEM CABLE VALIDATION TEST

Objective Outline:

The purpose of this test is to verify that the system cables for all the modules have been correctly installed.

Sample Output Loop configurations conform to the SATORP/ EPC approved PCS Vendor documents from the Marshalling Cabinet all the way through the DCS FoxSelect display.

NOTE:

Output testing can be achieved by measuring at the output terminals using a Multimeter. One Output per Termination Assembly will be exercised from the DCS FoxSelect Display and confirmed from the Marshalling terminals. The I/O Allocation and marshalling Wiring Schedule reports may also be used as references for performing these checks. I/O Test and Loop Test Report may be used to verify and ticked off.

Criteria:

There should not be any abnormalities with respect to the Output being tested.

Test Procedure:

1. Open the corresponding Block Template in the DCS Workstation FoxSelect
2. Connect the Multimeter to the corresponding Terminals in the Marshalling Cabinet. (Voltage for Digital points and Current for Analogue points)
3. For Digital points Simulate an 'Open' (OFF) state and 'Closed' (ON) state from the Display and observe the voltage level in the multimeter.
4. Perform a 2-point check on the analogue point by varying the output from the DCS over the full span to give approximately 4mA and 20mA (i.e. 0% 'OFF' and 100% 'ON'), and observe the current level in the multimeter.
5. Record results

O/P System Cable Validation Test		
PASS/FAIL CRITERIA	SAT	Comments
Verify using one Output per Termination Assembly that the output system cables have been correctly installed.	☐	
Measurement shall match the "ON" and "OFF" signal forced from the DCS Display	☐	

O/P System Cable Validation Test

A: System Identification		
DCS Area	:	DCS Area 3
Location	:	SS 1608B

B: Reference Documents		
Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested		
Tested By (Invensys personnel):		
Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness		
Witnessed By (SATORP personnel):		
Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance		
Accepted By (EPC personnel):		
Print Name	Signature	Date DD/MM/YY

13 DIAGNOSTIC MULTICORE VALIDATION TEST

Objective Outline:

The purpose of this test is to verify that the diagnostic Multicore cable have been correctly connected between the PCS cabinets and the DCS system.

Diagnostic Input Loop configurations conform to the SATORP/ EPC approved PCS Vendor documents from the PCS cabinet to the DCS System display.

Criteria:

There should not be any abnormalities with respect to the Diagnostic inputs being tested.

Test Procedure:

1. Exercise all Diagnostic points fro the respective cabinets
2. Confirm that the correct alarm is received on the DCS Displays
3. Record results

Diagnostic Multicore Cable Validation Test		
PASS/FAIL CRITERIA	SAT	Comments
Verify that all diagnostic points have been correctly installed.	☐	

Diagnostic Multicore Validation Test

A: System Identification

DCS Area	:	DCS Area3
Location	:	SS 1608B

B: Reference Documents

Title	Invensys Document No.	Revision No
PCS Networks & Cyber Security FDS	2271-PCS-FDS-001	Rev
DCS & ECS Systems FDS	2271-PCS-FDS-006	Rev
PIB/SS Interconnecting Block Diagram	SA-JER-PIAAA-PIXJ-060201	Rev 03

C: Tested

Tested By (Invensys personnel):

Print Name	Signature	Date DD/MM/YY

D: Comments

E: SATORP Witness

Witnessed By (SATORP personnel):

Print Name	Signature	Date DD/MM/YY

F: EPC Acceptance

Accepted By (EPC personnel):

Print Name	Signature	Date DD/MM/YY

14 UNSTRUCTURED TESTING

After completion of structured testing, unstructured testing may be completed by SATORP.

Unstructured testing is documented separately by SATORP.

15 COMPLETION OF DCS SYSTEMS SAT CERTIFICATE

DCS Area DCS Area 3
Location: SS 1608B

Test Details

DCS SAT Location: JUBAIL,SAUDI ARABIA

DCS SAT Start Date DCS SAT Completion Date:

Upon completion of the test.

- ☐ Ensure all master Invensys drawings / documents are marked up and are ready for redrafting
- ☐ Ensure all punch list items are either closed or transferred to the exception list
- ☐ Ensure SATORP/ EPC have signed off on Test Report and Test Certificates
- ☐ Ensure all design input documents are marked up and copied. Attach signed Installation Certificates.

Completion of DCS SAT Certificate

COMMENTS: _____

_____

_____

WITNESSED BY : _____ _____ _____

Invensys SATORP EPC

DATE : _____

APPENDIX A – TEST REPORT

TR Number: _____ Unit: _____ Delete: *Installation and Check out / SAT*

Originator _____ Date: _____

1) Fault/Issue Found

2) Action Required

3) Test to be Performed

4) Action Taken

Feedback to Engineering Team: Yes / No By: _____ Date: ____/____/____

PCS System Affected: (Tick One)	**Fault/Issue:** (Tick One)	**Fault Due To:** (Tick One)	**Importance:** (Tick One)
TMR : [ ] ESD [ ] F&G [ ] CCS [ ] BMS [ ] Safety PLC **Others :** [ ] DCS [ ] ECS [ ] MMS [ ] CCTV [ ] OTS	[ ] System Hardware [ ] Cabinets [ ] Cables [ ] Graphic [ ] Function Blocks [ ] Logic/Control Narrative [ ] Alarms [ ] Database	EPC [ ] Change SATORP [ ] Change Invensys [ ] Change [ ] Error [ ] Product Issue	[ ] Global Impact [ ] EPC Interface Issue [ ] Both of the Above

Corrected by Invensys:	**Checked by Invensys:**	**Accepted by EPC:**	**Witnessed / Accepted by SATORP :**
TQ Ref: _____ **Date:** ____/____/____	_____ **** Invensys Safety Authority:** _____ **Date:** ____/____/____	_____ **Date:** ____/____/____	_____ **Date:** ____/____/____

**** Invensys Safety Authority to Check ALL TMR System Test Reports.**

APPENDIX B – CABINET VISUAL INSPECTION CHECKLISTS

Cabinet Name	Drawing Number	Pass/Fail TR No.
S473-ECS-3-01	SA-JER-PIAAA-PIXJ-270202	
S473-ECM-3-01	SA-JER-PIAAA-PIXJ-270203	
S473-DCS-UTR-01	SA-JER-PIAAA-PIXJ-270204	
S473-IRC-3-01	SA-JER-PIAAA-PIXJ-270205	
S473-WSC-3-01	SA-JER-PIAAA-PIXJ-270206	
S473-DCM-UTR-01	SA-JER-PIAAA-PIXJ-270207	
S473-PDC-3-01	SA-JER-PIAAA-PIXJ-270208	
S473-ECM-3-02	SA-JER-PIAAA-PIXJ-270209	

APPENDIX C – PIB & SS INTERCONNECTING BLOCK DIAGRAM

Refer the SS 1608B Interconnecting Block Diagram SA-JER-PIAAA-PIXJ-060201.